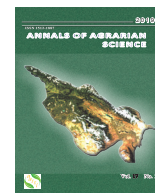




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# Definition of new herbal preservative optimal dose in cooked sausage meat

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## ABSTRACT

The infusion made from the extracts of Oregano (*Origanum vulgare* L), Thyme (*Thymus*), and Pennyroyal (*Mentha pulegium*), is a new preservative and has no impact on the sensory qualities of finished product and its safety quality. Furthermore, it allows cooked sausages to be stored at a low temperature for quite a long period. Meat processing companies operating in Georgia use „BOMBAL® ASC Super“ preservative produced by a German company “VAN HEES GmbH” in cooked sausage production. It was determined through research that the above-mentioned preservative can be replaced by a new herbal one proposed by us. The minimum amount of the latter in terms of 100 kg sausage meat main raw material is estimated to be 1200 ml. The indicated amount of the herbal preservative when storing at low, yet positive temperatures (+3...+4°C), for 30 days ensures the stability of chemical composition, physicochemical properties, and sensory qualities of cooked sausage “Lean-extra”. The finished product retains high quality and safety standards.

**Keywords:** Cooked sausage, Food additive, „BOMBAL® ASC Super“, Herbal preservative, Tasting, Sensory qualities.

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## Introduction

The retention of quality and biosafety of products for a particular period is considered to be one of the uppermost problems in food production [1-3]. From this perspective, the researchers employed in food industry focus their attention on avoidance of the negative effect of products, including meat and meat products on people’s health through the search for new, more effective food additives [4-6].

Generally, the main purpose of using additives in food industry is to improve the physicochemical qualities, the appearance of finished products, taste, flavor, and consistency of main raw material, as well as the desire to prolong the product’s shelf life and so on.

Food additives are used sparingly in the production of food products of particular brand and assortment, and this dose is considered to be safe for consumer health. On top of that, according to the existing data, a person receives on average 2,5-9,0 kg of such substances a year from vari-

ous products, which is not a small figure. There is a divergence of opinions in scientific literature whether additives, including preservatives, are harmful generally. Food producers consider that otherwise the additives would not be called “food additives” [7].

Doctors, nutritionists, and a large number of consumers disagree with such interpretation of the problem. However, they point out the potential harmfulness of some additives that have already reached into our bodies, as by interacting with the metabolism, they could cause unexpected reactions, often incompatible with life. Unfortunately, the effect of specific food additives on the physiological processes happening in the body as well as the possible effects on one’s genetics has not been defined. All food additives undergo chemical processing before given the final appearance. The latter should be taken into account to avoid inhomogeneous and even fatal outcomes. The risk of allergy reactions remains quite high, and their carcinogenic qualities have not been identified.

The safety quality of food additives and their permissible norm is defined by the United Nations FAO and WHO expert committee; this data is included in a specialized catalogue [8, 9] and is available for everyone interested. The relevant service agency of each particular country determines the regulation of various food additives usage [10-12].

From the safety perspective, food additives are divided into three groups in Codex Alimentarius system: I. “E” – safe, II. “E” – additives permissible for use in food production and III. “E” – forbidden. Consumer rights organizations in many countries call group number II additives “the technical components of food”, and the use of which is essential for development of food industry. They claim these additives are safe for consumers. Meanwhile, it has been determined that not everything is so uniform and attractive. Their negative impact on human body has also been revealed [13].

The additives offered nowadays contain substances of various composition and effect mechanisms. They include emulsifying agents, flavouring agents, antioxidants, dye, preservatives as well as a wide range of so called technical additives. „E\*\*”, i.e. E200-E299 substances and preservatives, represent the main concern of production engineers and nutritionists. It is the topic of heated discussions and serious doubt. The disastrous effect of these additives on microorganisms has been identified, which allows to avoid food contamination by microorganisms for a long period, that is to grow its shelf life. Thus, the effect of food additives is similar to antibiotics, but the mechanism which dictates the suppression of microorganisms is certainly different. When consuming preservatives that are presently approved, the following is expected to occur: digestive system and some internal organs dysfunction, the development of allergic reactions, migraine, skin diseases, breathing problems, carcinogenic formation and so on [14].

Of various cooked sausage storage facilitation substances, Georgian meat processing factories use „*BOMBAL® ASC Super*“ preservative (produced in Germany by „VAN HEES“) [15]; it constitutes a mixture of three additives: Sodium Pyrosulphite (E223), Sodium Acetate (E262), and Sodium Citrate (E331). It was also determined that when these substances get into the digestive tract, it leads to

a high level of risk [16]. The same is true for all non-organic preservatives [17, 18].

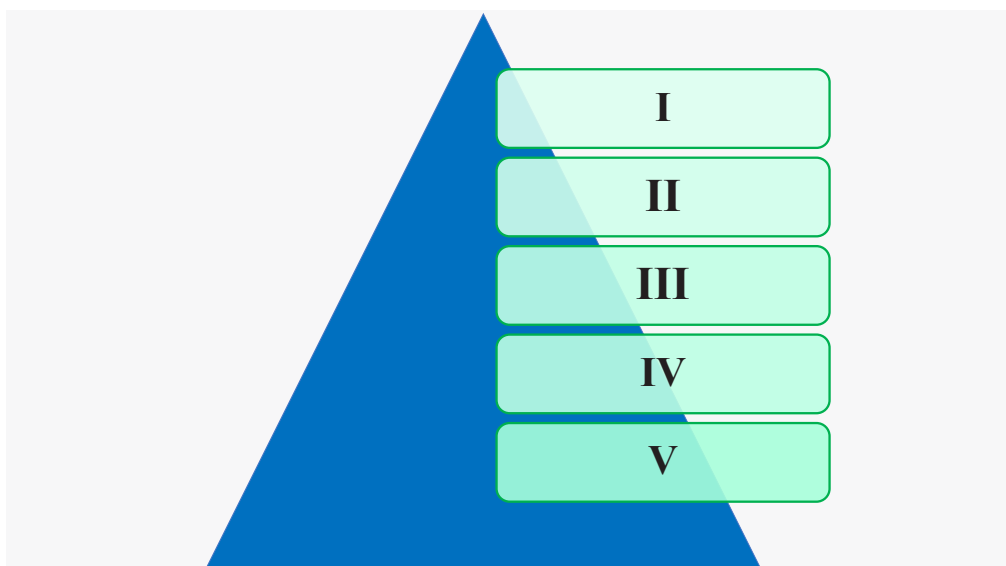
In the scientific literature, there had been a presumption, which was later proved in practice, that herbal preservatives possessing antimicrobial qualities prolong the shelf life of sausages. Some of them even hinder the lipid oxidation process and/or the change in sausage meat color [19]. Moreover, the research showed that some herbs with preservative qualities, for example Rosemary extract, are useful for human health and protect it from various malignant tumour formations.

Based on the above-mentioned fact, a research dedicated to the discovery of new substances and materials of herbal origin that represent a lower risk for the human body (or even the absence of any risk), providing similar effect, is becoming quite significant and, due to its urgency, expands to a larger scale.

It has been determined by us that adding 1,5 l of Oregano (*Origanum vulgare* L), Thyme (*Thýmus*), and Pennyroyal (*Mentha pulegium*) extracts (these species grow naturally in Georgia and are cultivated as well) in 100 kg of sausage meat guarantees storing sausages for up to one month, retaining their quality. In particular, organoleptic and microbiological research showed that sensory qualities of finished products are practically unaffected by the 30<sup>th</sup> day after production. Microbial contamination level is lower than the minimal requirement identified for products [20-22].

## Materials and methodology

The experiment was held on the base of Georgian meat producing company “Iveria” (ISO 22 000). In order to determine the minimum amount of Oregano (*Origanum vulgare* L), Thyme (*Thýmus*), and Pennyroyal (*Mentha pulegium*) extract in “Lean-Extra” sausage meat, we prepared and studied 2 control and 3 trial variants of sausages, including the following: sausage meat in the I control group was prepared without preservatives; we added 0.80, 1.20 and 1.50 l of herbal preservative to sausage meat in control groups number II, III, and IV respectively, in terms of 100 kg of main raw material. As to group number V, 0,3 g of “*BOMBAL® ASC SUPER*” was added according to the approved formulation applied by the company.



**Fig. 1.** Trial and control variants of cooked sausage “Lean-Extra” produced by adding various types and amounts of preservatives.

#### Conditional observations:

I control group: without preservatives; II trial group: 800 ml herbal preservative per 100 kg ground meat; III trial group: 1200 ml of herbal preservative per 100 kg ground meat; IV trial group: 1500 ml of herbal preservative per 100 kg ground meat; V control group: 0.3 g “BOMBAL® ASC SUPER” per 100 kg ground meat.

The amount of other auxiliary ingredients of the formulation in trial and control variants in terms of 100 kg ground meat was the same and amounted to 7.25 kg. 17.5 kg of water (flake ice) was added to control variants I and V ground meat. The amount of water in II, III and IV variants was regulated in terms of the herbal preservative water solution in physical form and constituted 16.70, 16.30, and 16.00 kg respectively.

Main raw materials, as well as flavoring and functional additives, were produced according to the regulation applied by the company. The ground meat was prepared in a vacuum cutter-mixer in the following order:

According to the formulation, first we placed the main raw material consisting of 20 kg mechanically softened ground mixture of meat and chicken in the machine bowl, added pork fat emulsifier, pork skin protein-fat emulsifier. After rotating the bowl twice, we added specifically defined amount of herbal extract and flake ice in II, III, and IV variants of ground meat; while “BOMBAL® ASC SUPER” and flake ice were added in V ground meat variant. On top of that, we added table salt, spices, Sodi-

um Nitrite and other ingredients. After 2.5-3 minutes of mixing, starch and milk serum protein were added in the bowl, after that the bowl was covered with the lid and vacuum pump of the machine was turned on. The chopping and mixing process took 8-10 minutes, at +9 °C temperature. Number I sausage ground meat variant was also made under the described regulations, but without adding preservatives.

After finishing the mixing process, the finished ground meat remained in the bowl for 30 minutes, was weighed and placed into a vacuum pump stuffer receiver. In order to pump the ground meat, “Agro-Pac” 60 mm diameter multilayer polyamid casing was employed, which along with having antimicrobial resistance, mechanical resistance and flexibility, hardly allows any moisture or air through. These features are particularly essential in cooked sausage storing process.

The ground meat stuffing pressure was 4-6 kg/ cm<sup>2</sup> (3,92-5,88·10<sup>5</sup> Pascal); placed in casings, semi-finished ground meat was divided by hand stationary clips machine into 150-160 mm long, ~400 g loaves that were then hung on a wheeled rack to drain for 1 hour at +20...+25 °C.

Sausage loaves were boiled in water at +83 °C, (reaching +74 °C in the center of a loaf), which took 70-75 minutes. Boiled loaves were placed under a cold water shower, where the cooling procedure lasted for 1 hour and 40 minutes until the temperature in the upper layers of the loaves reached +25 °C. Next the sausage loaves were transferred to the

storing facility for 12 hours under the conditions of +4 °C and 95% relative moisture until they reached the selling temperature (+12 °C and less).

In order to study storing stability, the sausage loaves were stored in a domestic fridge at a low, but positive temperature (+3...+4 °C) and 85-90% moisture.

## Results and analysis

The trial and control sausage meat contained 20 kg of main raw materials; the amount of other components, materials and additives complied with the factory approved formulation, whereas preservatives and flake ice were added in accordance with the scheme designed by us, based on the amount of main raw material. Finally, the mixed masses of all variants of prepared ground meat made up 25,95 kg (Table 1).

We studied the chemical composition of finished products in the laboratory of Agricultural Univer-

sity of Georgia under the requirements of GOST R 52196-2017 [23]. It was determined that the chemical composition indices of the trial and control samples complied with the developed technical regulation of the factory and were hardly different from one another. For instance, according to the data in Table 2, sausages of control variant I and trial variants II, III, and IV differ in moisture and dry substances by 1.10-1.23, in fats – by 0.81-1.10, in proteins – by 0.12-0.13, and in carbohydrates – by 0.15-0.38 g per 100 g. Products of control variant V and trial variants II, III, and IV differ in the same substances by 0.42-0.55, 0.06-0.22, 0.09-0.16 and 0.27-0.50 g per 100 g respectively.

The minimal difference in the chemical composition of the trial and control sausages resulted in an almost similar energy value, which fluctuated within 181-192 Cal, i.e. 760-806 kJ per 100 g.

**Table 1.** “Lean-Extra” trial and control sausage meat formulation

Names of Ingredients	Unit of Measurement	Variant				
		I Control	II Trial	III Trial	IV Trial	V Control
Main raw material	kg	20	20	20	20	20
“BOMBAL® ASC SUPER”	Kg	0,00	0,00	0,00	0,00	0,08
Herbal preservative	ml	0,00	0,160	0,240	0,300	0,00
Other auxiliary ingredients	kg	1,45	1,45	1,45	1,45	1,45
Flake ice	kg	3,5	3,34	3,26	3, 20	3,50
Total	kg	24,95	24,95	24,95	24,95	25.03

**Table 2.** Chemical composition of trial and control sausage samples (g/100 g) and energy value (Cal/kJ) per 1000 g.

Index	Variant				
	I, Control	II, Trial	III, Trial	IV, Trial	V, Control
General Moisture	68,98	67,75	67,85	67,88	68,30
Dry Substance	31,02	32,25	32,15	32,12	31,70
Fat	13,59	14,69	14,56	14,40	14,62
Protein	10,07	10,19	9,94	10,19	10,05
Carbohydrate	4,36	4,51	4,74	4,67	4,22
Table Salt	2,26	2,20	2,21	2,24	2,23
Mineral Substances	0,74	0,66	0,70	0,62	0,58
Energy Value	181 / 760	192 / 806	191 / 801	191 / 801	190 / 796

Prior to distribution, the chemical laboratory of the producing factory studies chemical composition of finished products and their physicochemical properties as well as conducts tasting. In our case, by studying the chemical composition it was determined that sausages of all variants contained 2.2 % of table salt, their moisture was 70%, and active reaction (pH) was within the range of 6.7. Every product also gained a positive appraisal from the members of engineering staff who participated in the tasting process.

According to the methodology, the final outcome of the commercial value determination of sausage as a food product depends largely on consumer opinions, i.e. the outcomes of tasting.

Complying with the research technique, in order to evaluate gustatory and sensory properties of the trial and control sausage variants, tasting was held at the Faculty of Agricultural Sciences and Biosystems Engineering of Georgian Technical University GOST 9959-2015 [24] and GOST R ISO 8588-2008 [25]. Complying with the given regulations, the professor-lecturers, technical staff and PhD students of the university participated in the tasting. The tasting involved two steps: at the initial stage of the production, on the 3<sup>rd</sup> day, and on the last possible point past expiry date, i.e. on the 30<sup>th</sup> day. The participants evaluated the gustatory (taste, flavor) and physico-

chemical (color, consistency, succulence) properties by a 9-grade scale. First they evaluated the product appearance: the correlation between the condition of sausage loaf surface and its shape, the color of sausage meat, porosity and solidity, then the flavor, taste, consistency and succulence.

The results of the tasting cards empirical data collation are shown in Table 3 (drawings 2 and 3).

It was determined that the sample taken on the 3<sup>rd</sup> day after production had not caused significant differences in judgements. Variant IV (trial), sausage cooked with herbal preservative in terms of 1.5 l per 100 kg of ground meat, also gained the highest average evaluation according to the five indices. Variant I (control), cooked by the traditional formulation applied in the factory, but without preservatives, received the lowest evaluation.

When tasting sausages on the 30<sup>th</sup> day after production, and observing the appearance of the slices, the participants' attention was drawn to the sausages cooked without preservatives. The surface of ground meat was clearly porous and had occasional moist patches, in comparison with the other samples.

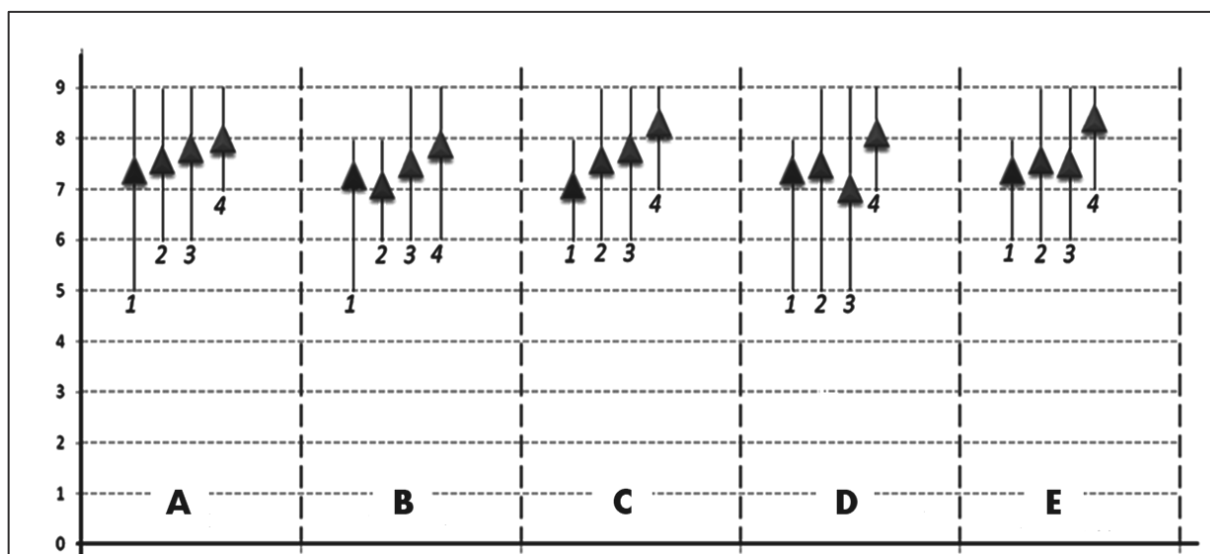
Sausage meat slices of other samples were solid and dry. As to the sausage meat cooked with herbal preservative, its slice had a more attractive pinkish, milky pink color, than when using „BOMBAL® ASC Super “.

The processing of empirical data of tasting conducted on the 30<sup>th</sup> day after production showed that according to color, taste and consistency, variant I

sausage, which had been cooked without preservatives, received the lowest average mark - 6.53.

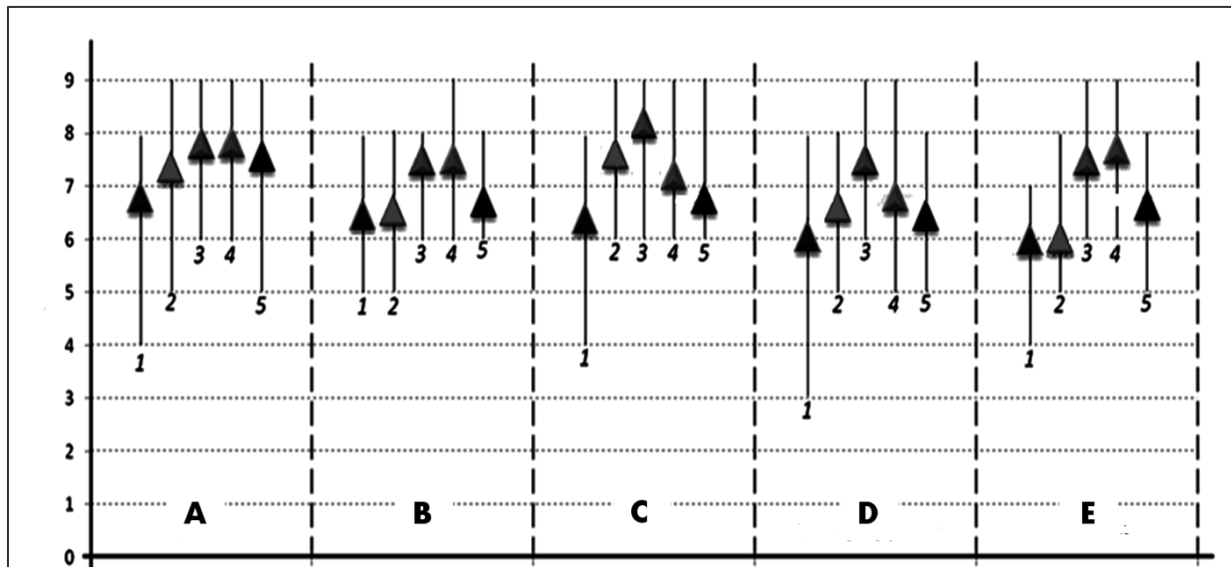
**Table 3.** Results of tasting cooked sausage “Lean-Extra” control and trial samples

Variant	Color	Flavor	Taste	Consistency	Succulence	Average mark
On the 3 <sup>rd</sup> day after production						
I - control	7,4±0,460	7,2±0,412	7,1±0,227	7,3±0,375	7,4±0,324	7,30±0,254
II - trial	7,6±0,375	7,1±0,350	7,6±0,324	7,5±0,463	7,6±0,420	7,50±0,288
III - trial	7,8±0,313	7,5±0,379	7,8±0,366	7,0±0,534	7,5±0,378	7,50±0,302
IV - trial	8,0±0,189	7,9±0,350	8,3±0,313	8,1±0,295	8,4±0,263	8,12±0,230
V-control	–	–	–	–	–	–
On the 30 <sup>th</sup> day after production						
I - control	6,8±0,563	6, 5±0,365	6,4±0,516	6,3±0,803	6,3±0,847	6,53±0,489
II - trial	7,3±0,843	6,7±0,342	7,7±0,558	6,8±0,792	6,3±0,381	6,93±0,191
III - trial	7,8±,0792	7,5±0,342	8,2±0,543	7,7±0,61	7,5±0,563	7,73±0,399
IV - trial	7,8±0,619	7,5±0,843	7,5±0,428	7,0±0,730	7,7±0,957	7,50±0,422
V-control	7,5±0,477	7,0±0,342	7,0±0,428	6,6±0,730	6,8±0,494	6,98±0,397



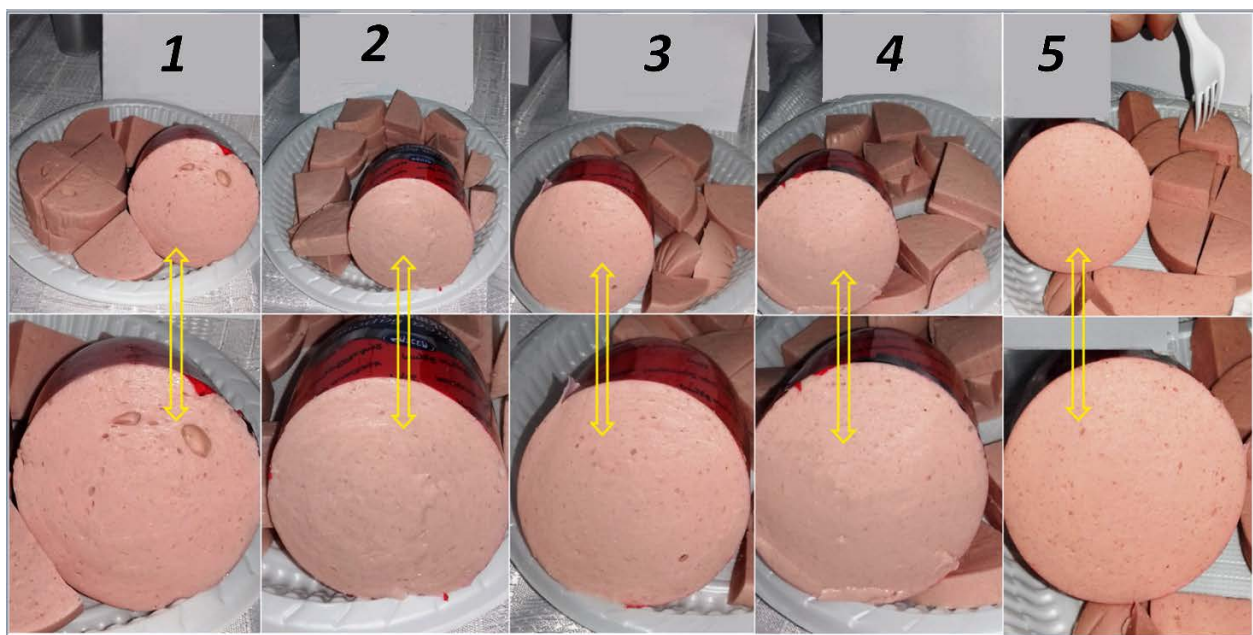
**Fig. 2.** Results of sausage tasting on the 3<sup>rd</sup> day after production

Notational Conventions - ▲ - average mark; ⊥ - minimal mark; ⊥ - maximal mark; A - colour; B - flavour; C - taste; D - consistency; E - succulence; 1, 2, 3, 4 variants.



**Fig. 3.** Results of sausage tasting on the 30<sup>th</sup> day after production

Notational Conventions-▲ - average mark; ⊥ - minimal mark; ⊥ - maximal mark; A - colour; B - flavour; C - taste; D - consistency; E -succulence; 1, 2, 3, 4, 5 variants.



**Fig. 4.** Sausage trial and control samples on the 30<sup>th</sup> day after production

Notational Conventions - 1, 2, 3, 4, 5 – presented at the tasting the samples of cooked sausage “Lean-Extra” I, II, III, IV and V variants.

According to the five parameters, III and IV variants products received the highest average mark. These samples had been made by adding 1.2 and 1.5 of herbal preservative per 100 kg of main raw material. As to the average evaluation of sausage cooked by the traditional formulation applied at the factory, i.e. using “BOMBAL® ASC SUPER”, it was insignificantly, by 0.52-0.75 marks, lower than III and IV variants produce (Table 3).

It must be mentioned that variant I and II products received significantly higher evaluation when tasting was conducted on the 3<sup>rd</sup> day after production than on the 30<sup>th</sup> day. As to variants III and IV sausage, their evaluation results received on 30<sup>th</sup> day hardly differed from those received on the 3<sup>rd</sup> day.

## Conclusion

Introducing Oregano (*Origanum vulgare* L), Thyme (*Thýmus*), and Pennyroyal (*Mentha pulegium*) extract 0.8; 1.2 and 1.5 l per 100 kg ground meat, instead of “BOMBAL® ASC SUPER” included in cooked sausage “Lean-Extra” formulation, doesn’t practically change the chemical composition and physicochemical properties of finished product.

Sausage meat made with the herbal preservative is homogeneous, more attractive, of pinkish (milky pink) shade and hardly differs from the products made by following regulations applied in the factory.

All control and trial samples received quite high evaluation in every parameter in tasting that was held on the 3<sup>rd</sup> day after production.

After tasting samples that had been stored at low positive temperatures on the 30<sup>th</sup> day it was determined:

- sausage samples that had 1.2 -1.5 l of Oregano (*Origanum vulgare* L), Thyme (*Thýmus*), and Pennyroyal (*Mentha pulegium*) extract added per 100 kg of main raw material received a higher mark. As to sausage made by adding 0.8 l of herbal preservative per 100 kg of main raw material, it received a lower mark than variants III and IV as well as variant V.
- according to the standard regulation applied in the factory, the average evaluation of cooked sausage made with “BOMBAL® ASC SUPER” is a little lower than variants III and IV that had been made with herbal preservative.
- sausage meat made without adding a preservative was porous, had slightly changed color and occasional moist patches on the slice.

In terms of 100 kg of main raw material, 1.2 l of Oregano (*Origanum vulgare* L), Thyme (*Thýmus*), and Pennyroyal (*Mentha pulegium*) extract helps to maintain physiochemical and sensory properties of finished product stored at +3, +4 °C for 30 days.

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